(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 913 770 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
29.10.2003 Bulletin 2003/44

(43) Date of publication A2:
06.05.1999 Bulletin 1999/18

(21) Application number: **98120192.4**

(22) Date of filing: **30.10.1998**

(51) Int Cl.[7]: **G06F 9/46**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **31.10.1997 US 962140**
30.06.1998 US 107690

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(54) Method and apparatus for sharing a time quantum

(57) A method and apparatus for allowing a first thread (112) to "share" its remaining time quantum with a second thread (112) when the first thread is blocked. A thread (112) may be blocked, for example, if it is waiting for a resource such as a data file or a lock. A thread may also be blocked if it is waiting for an event, such as a user keystroke. If there is a thread on the run queue that "owns" the resource needed by the consumer thread, the blocked consumer thread transfers its right to execute for a remaining time quantum to the owner thread, and the owner thread executes next. If the threads (112) are in a same process (110), this transfer means that no process context switch is required, since the consumer thread and the owner thread are threads of the same process (110). In addition, this transfer means that the time before the resource becomes available to the blocked consumer thread will be short. Similarly, if a consumer thread is blocked to await an event, such as a user keystroke, the blocked consumer thread's remaining time quantum are transferred to another thread in that is waiting on the run queue for its turn to execute. Again, if the threads (112) are in a same process (110), this transfer avoids having to perform a context switch between processes.

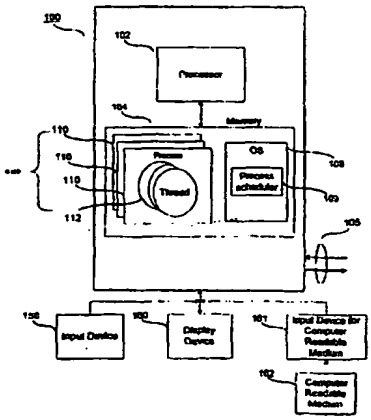

Fig. 1
Multi-threaded Applications Sharing a Single Processor

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EUROPEAN SEARCH REPORT

Application Number
EP 98 12 0192

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	STOICA I., ABDEL-WAHAB H., JEFFAY K., BARUAH S. K., GEHRKE J. E., PLAXTON C. G.: "A PROPORTIONAL SHARE RESOURCE ALLOCATION ALGORITHM FOR REAL-TIME, TIME-SHARED SYSTEMS" PROCEEDINGS 17TH IEEE REAL-TIME SYSTEMS SYMPOSIUM, 'Online! 4 - 6 December 1996, pages 288-299, XP002244580 LOS ALAMITOS, CA, US ISBN: 0-8186-7689-2 Retrieved from the Internet: <URL:http://ieeexplore.ieee.org/ie13/4270/12245/00563725.pdf> 'retrieved on 2003-06-17!	1-4, 7-10, 15-18, 21,22	G06F9/46
A	* abstract * * page 289, left-hand column, line 17 - line 25 * * page 289, right-hand column, line 6 - line 15 * * page 289, right-hand column, line 43 - page 290, left-hand column, line 34 * * page 292, right-hand column, line 8 - line 12 * * page 293, left-hand column, line 33 - right-hand column, line 11 * * page 294, left-hand column, line 12 - right-hand column, line 18 * * page 295, right-hand column, line 14 - line 40 *	5,6, 11-14, 19,20	
A	US 5 506 987 A (ORBITS DAVID A ET AL) 9 April 1996 (1996-04-09) * abstract * * column 2, line 10 - column 3, line 4 *	1,8,16, 21,22	

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TECHNICAL FIELDS SEARCHED (Int.Cl.6)

G06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 September 2003	Archontopoulos, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
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D : document cited in the application
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EPO FORM 1503 03.82 (P04C01)

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A	STOICA I., ABDEL-WAHAB H., JEFFAY K.: "ON THE DUALITY BETWEEN RESOURCE RESERVATION AND PROPORTIONAL SHARE RESOURCE ALLOCATION" PROCEEDINGS OF THE SPIE - THE INTERNATIONAL SOCIETY FOR OPTICAL ENGINEERING, MULTIMEDIA COMPUTING AND NETWORKING, 'Online! vol. 3020, 10 - 11 February 1997, pages 207-214, XP002244581 san jose, ca, us ISSN: 0277-786X Retrieved from the Internet: <URL:http://www.cs.unc.edu/{jeffay/papers/MMCN-97.ps> 'retrieved on 2003-06-17! * abstract * * page 208, line 34 - page 209, line 4 *	1,8,16, 21,22	
A	DROZDOWSKI M.: "SCHEDULING MULTIPROCESSOR TASKS - AN OVERVIEW" INSTYTUT INFORMATYKI POLITECHNIKA POZNANSKA, 'Online! 1996, XP002244582 POZNAN, PL Retrieved from the Internet: <URL:http://www.cs.put.poznan.pl/mdrozdowski/txt/multi2.ps> 'retrieved on 2003-06-17! * abstract * * page 3, line 1 - line 8 *	1,8,16, 21,22	TECHNICAL FIELDS SEARCHED (Int.Cl.6)

The present search report has been drawn up for all claims

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Application Number
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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☒ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 98 12 0192

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-11, 15-22

   The unused time in the quantum time of a thread is added to a time quantum of the next thread to be executed.

2. Claims: 12-14

   Decrementing the number of tickets of a process whose thread hast just finished executing for a predetermined time period and setting the number of tickets to the initially fixed amount when the number of tickets for the process is zero.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 12 0192

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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02-09-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5506987 A	09-04-1996	NONE	